Universal Camouflage For The Future Warrior

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Individual Protection Directorate/

Supporting Science and Technology

The Science Behind the Warrior:

Directorate

Yesterday, Today and

15 December 2004

Outline

- ***Objective***
- ***Current Camouflage***
- ***Approach***
  - *Pattern Development*
  - *Color Development & Optimization*
- ***Field Evaluations***
  - *Test Methodology*
  - *3 Phases of Evaluations*
    - *Near Infrared (NIR) Results*
    - *Pattern Modifications*
  - *System Level Field Evaluation*
- ***Data Analysis***
- ***Conclusions***

Objective

Develop Improved/universal Camouflage (Vis & NIR Properties) Pattern(s) That Address the Changing Threat(s) to the Warfighter in Support of the Future Force Warrior (FFW) Program and Army Transformation.

Woodland

Urban

Desert

Future Force Warrior (FFW)

The ensemble will be the foundational centerpiece for the human interface, load bearing, electronics hardware linkages, and multiple levels of protection.

Major Thrust Areas:

- Textile Materials Integration
- Electrotextiles
- Flame Protection
- Signature Management

Current Camouflage Protection

Approach –
Pattern & Color Development

- **Evaluated Commercial & Military Patterns**
  - Design Considerations
- **Designed and Down-selected to 2 Camouflage Patterns**
  - 1 design with 2 variations
  - Out of the box design
- **Selected Colors for 3 Terrain (Desert, Urban)**
  - Terrain Spectral Data
- **Optimized Colors by Selecting *Common* ground shade color patterns.**

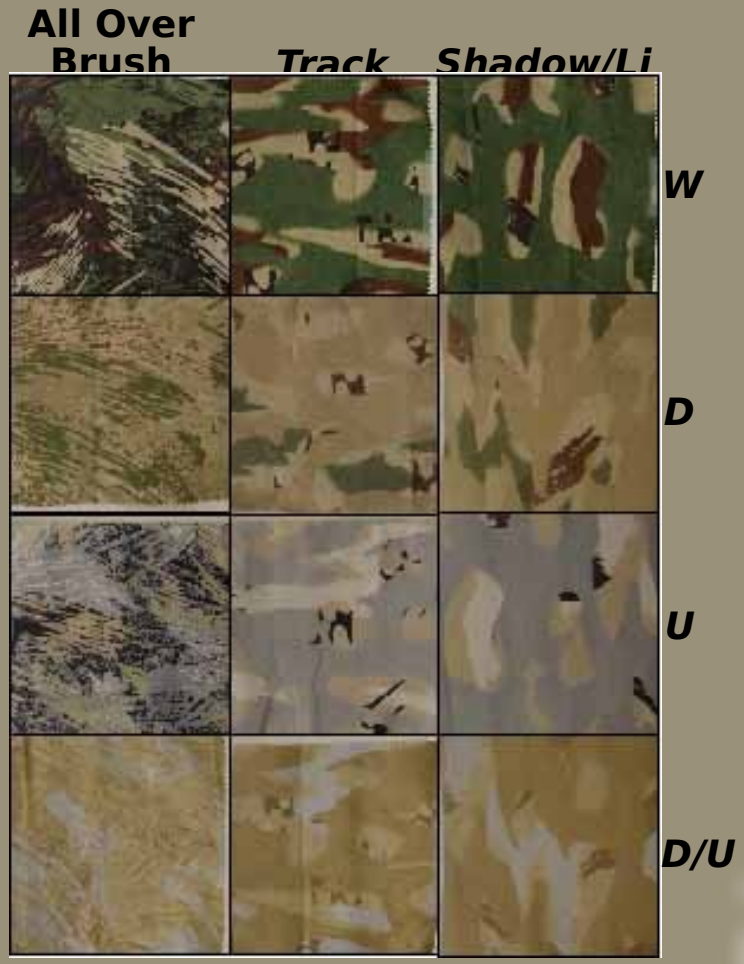
  Green Light Tan
  - Minimize logistic issues (uniforms, equipment)

Approach –
Color Optimization

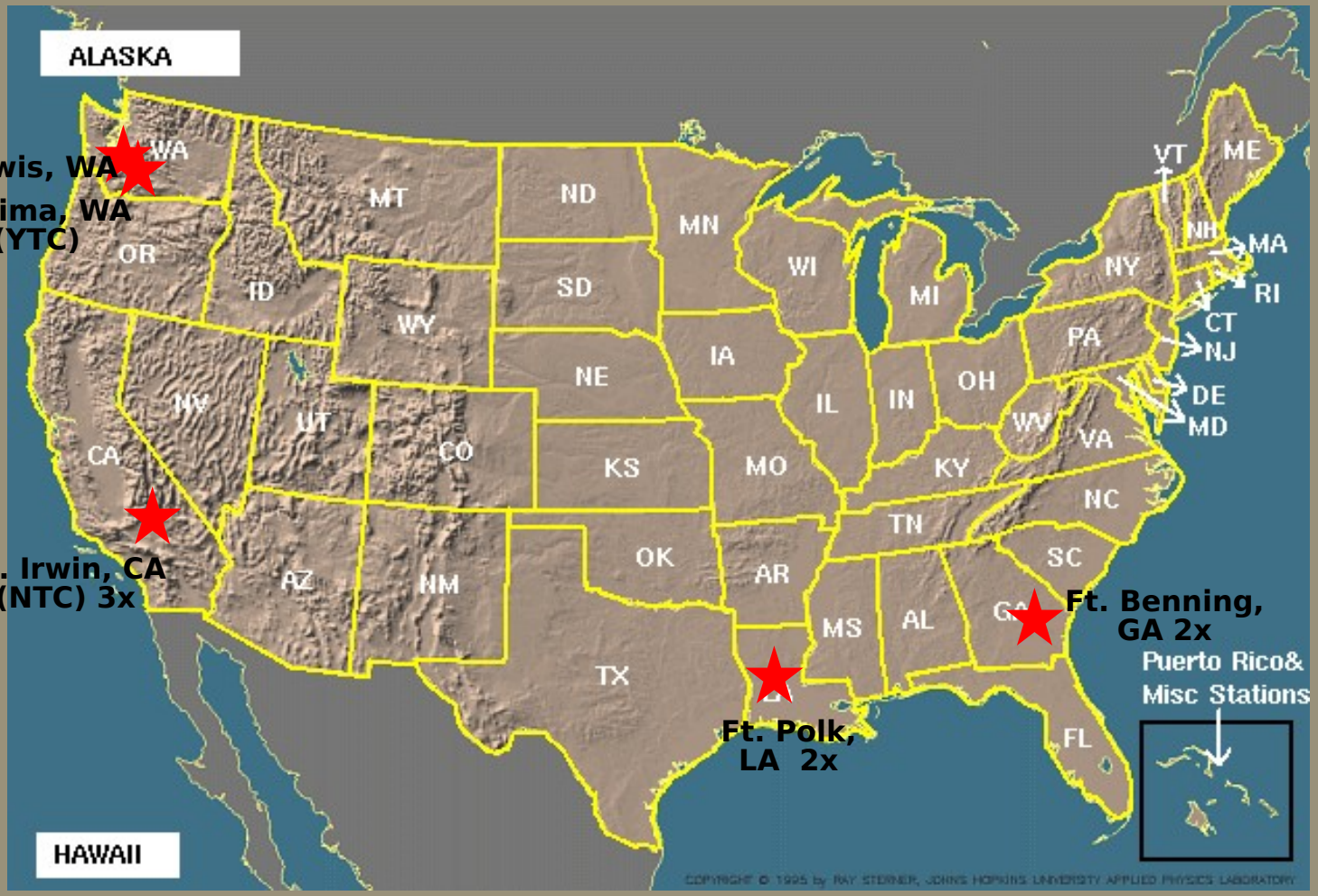
Developed 3 patterns with 4-color combinations (woodland, desert, urban, and desert/urban).

Terrain	Colors
Woodland (W)	Tan*, Green, Brown, Black
Desert (D)	Tan*, Dark Tan, Khaki, Brown
Urban (U)	Tan*, Light Gray, Medium Gray, Black
Desert/Urban (D/U)	Tan*, Dark Tan, Light Gray, Brown

*** Common Color**



Field Sites/Installations



***Fifteen (15) evaluations total**

Field Evaluation(s) – Evaluation Variables

PURPOSE- *To visually evaluate the camouflage effectiveness of various patterns in a field environment.*

Phase	Camouflage Print Type	Terrain	Dates	NIR Testing	# Candidates Evaluated	Backgrounds	Observer Station Ranges from Target (Meters)					
							Day (m)			Night (m)		
I	Ink Jet Printed	W	Aug 02		9	3	60	120	180			
		U	Aug 02		13	3	60	120	180			
		D	Oct 02		10	3	60	120	180			
II	Production Printed	W	Feb 03	Yes	11	3	60	120		30	50	
		U	Feb 03	Yes	11	3	60	120		35	70	
		D	Apr 03	Yes	11	3	60	120		30	60	
III	Modified Designs & Production Printed	W	Oct 03	Yes	11	3	60	120		35	65	
		U	Oct 03	Yes	11	3	60	120		35	65	
		D	Nov 03	Yes	11	3	60	120		35	65	
IV	FFW System Ensemble	W	Mar 04	Yes	4	4	90			30		
		U	Mar 04	Yes	4	4	90			30		
		D	Mar 04	Yes	4	4	90			30		
		W	Apr 04	Yes	4	4	90			35		
		U	Apr 04	Yes	4	4	90			35		
		D	Mar 04	Yes	4	4	90			30		

W – Woodland, U – Urban, D – Desert

Field Evaluation Plan – Cont.

- Camouflage Evaluation Scale Ratings based on:
  - **Blending**
  - **Brightness (Phase I)**
  - **Contrast (Phase I)**
  - **Detection (Phase I)**
- Random Order User Evaluation
  - **Evaluated 4 – 13 patterns**
  - **Trained Military Soldiers**

How well does this uniform blend with the background. Indicate with a slash mark on this line.

Does not blend at all with the background ——————————— Cannot distinguish from background

Pick the MOST TRUE statement from the following. (circle one number)

1 This uniform is TOO DARK for this background.

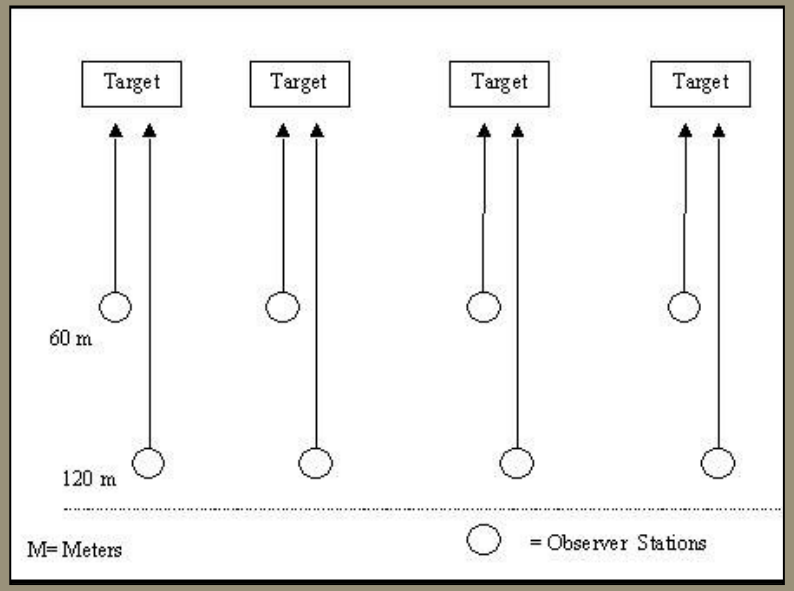
2 This uniform is TOO LIGHT for this background.

3 This uniform has INAPPROPRIATE COLORS for this background. What color: _____

4 Other (please write in your explanation) _____

Field Evaluation Plan – Cont.

- Various backgrounds (3 – 4) at several distances (1 to 3), consisting of various orientations (standing, crouched, prone).



Phase	Target Postures - Observer's View of Targets			
I	Standing Back View	Kneeling Back View	Prone Side View	
II	Standing Back View			
III	Standing Back View			
IV	Standing Back View	Kneeling Back View	Standing 45 deg. Angle View Front / Right-Side	Standing 45 deg. Angle View Front / Left-Side

Field Evaluation Plan – Cont.

- Phase I –
  - **Day only**
    - Evaluation of each candidate one at a time
    - Side-by-side/forced comparison
- Phase II, III –
  - **Day and Night**
    - Evaluation of each candidate one at a time
- Phase IV –
  - **Day**
    - Evaluation of each candidate one at a time
    - Side-by-side/forced choice comparison
  - **Night**
    - Evaluation of each candidate one at a time

1st Phase Of Evaluations

- *Eliminated:*
  - *Shadow Line (Woodland, Desert, Urban, and Desert/Urban).*
  - *All Over Brush (Urban and Desert/Urban).*
- *Accepted:*

All Over Brush

Woodland

Desert

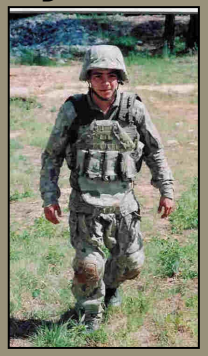
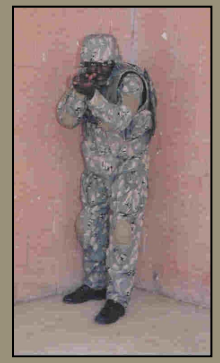
Track

Woodland
Desert

Urban
Desert/Urban)

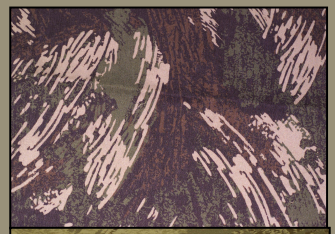
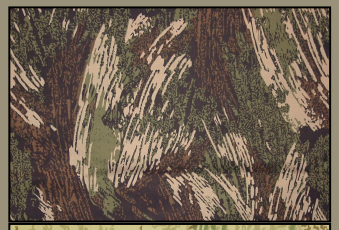
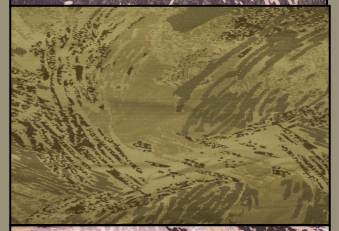
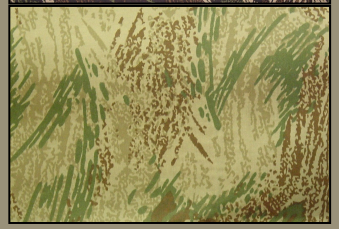
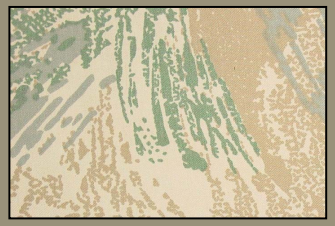
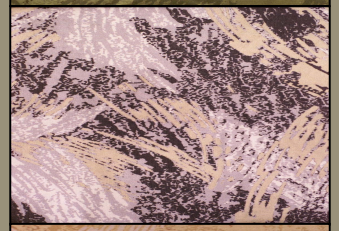
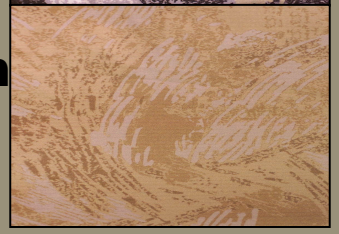
Pattern Changes Within Phases

Track Design

	Phase I	Phase II	Phase III (Mods)	Phase IV (System)
Woodland Track				
Desert Track				
Urban Track				
Desert/Urban Track				

Pattern Changes Within Phases

Brush Design

	Phase I	Phase II	Phase III (Mods)	Phase IV (System)
Woodland Brush				
Desert Brush				
Urban Brush				
Desert/Urban Brush				

Print Production –
Near Infrared Results (NIR)

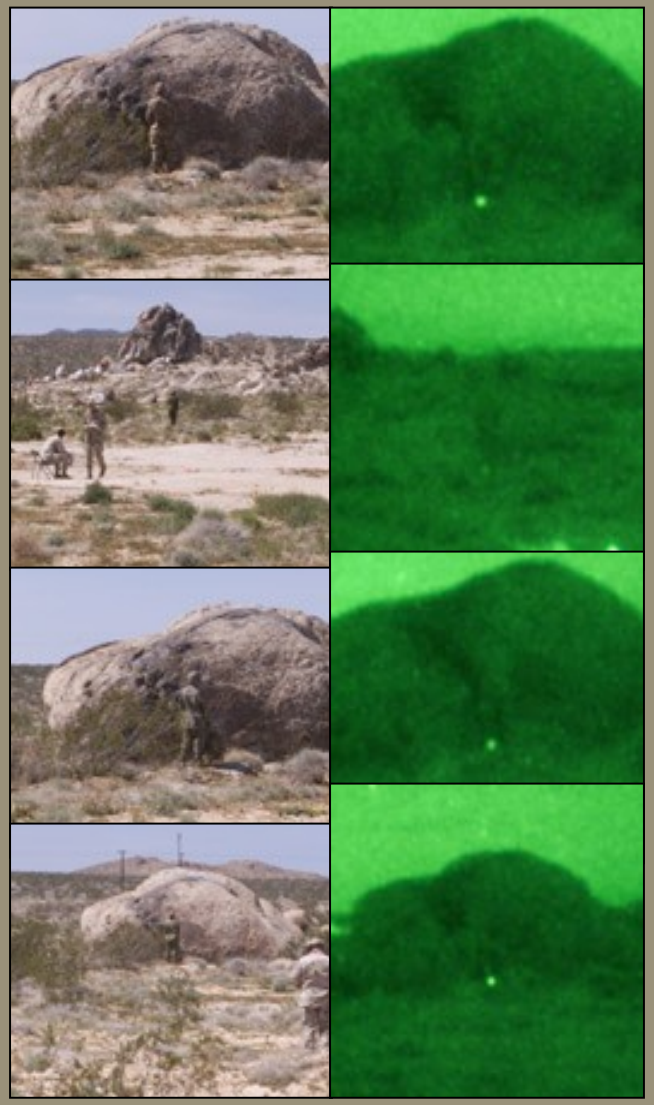
- *Acceptable* Colors:
  - **Black**
  - **Medium Gray**
  - **Medium Tan**
- *Unacceptable* Colors:
  - All remaining colors.

Terrain	Colors
Woodland (W)	Light Tan*, Green, Brown, **Black**
Desert (D)	Light Tan*, Tan, Khaki, Brown
Urban (U)	Light Tan*, Light Gray, **Medium Gray**, Black
Desert/Urban (D/U)	Light Tan*, Light Gray, **Medium Tan**, Dark Tan

*** Common Color**

Down Selected – Phase II to III

- ***Desert Brush***
  - *Desert Brush Modified*
- ***Woodland Track***
  - *Woodland Track Modified*
- ***Urban Track***
  - *Urban Track Light Modified*
  - *Urban Track Dark Modified*
- ***Contractor-Developed***
  - *Contractor-Developed Modified*



Down Selected – Phase III to System Level

- ***Desert Brush***
- ***Woodland Track Mod***
- ***Urban Track***
- ***Contractor-Developed Mod***

System Level Evaluations

Urban Environment

Woodland Environment

Desert Brush

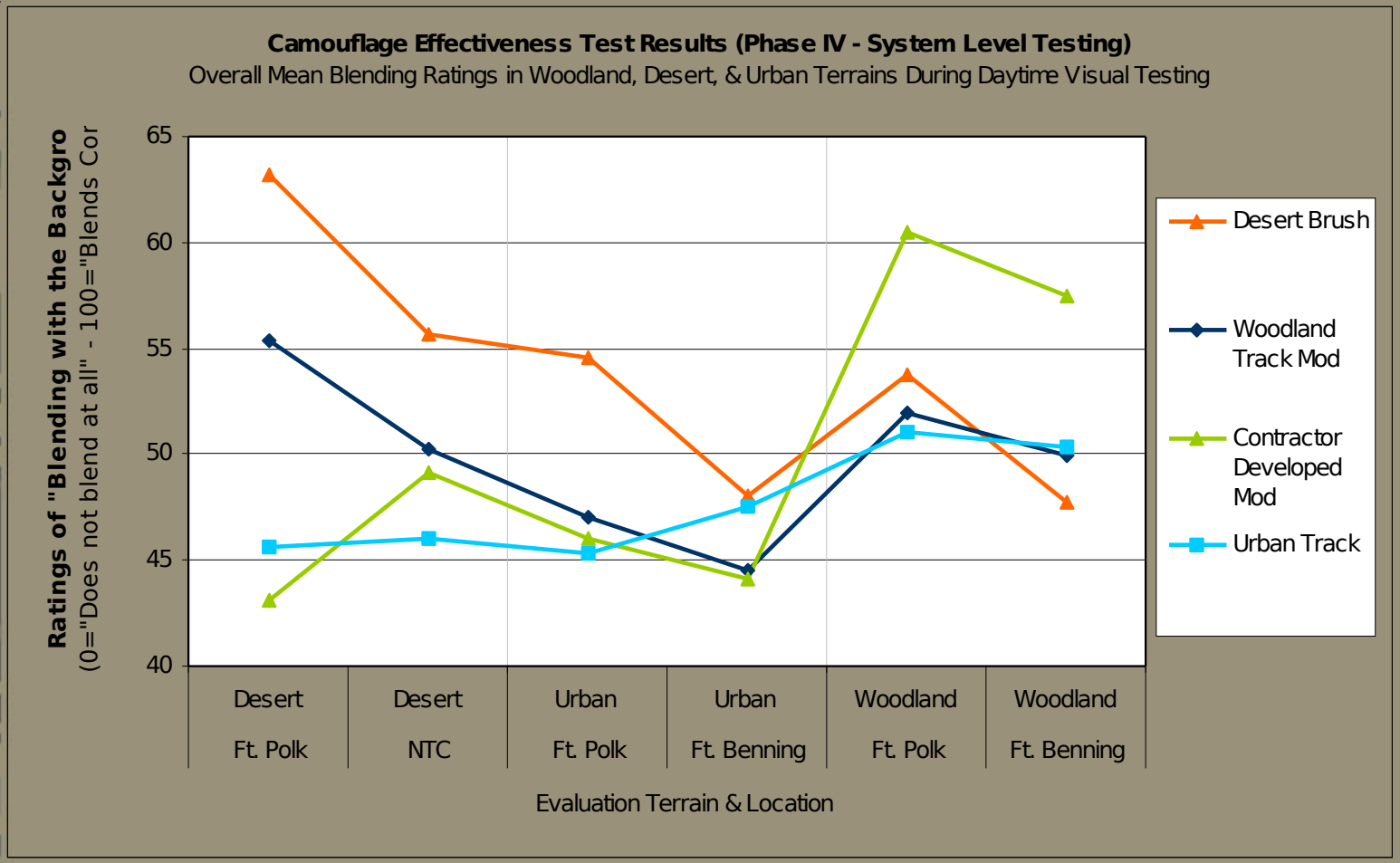
Contractor-Developed Mod

Woodland Track Mod

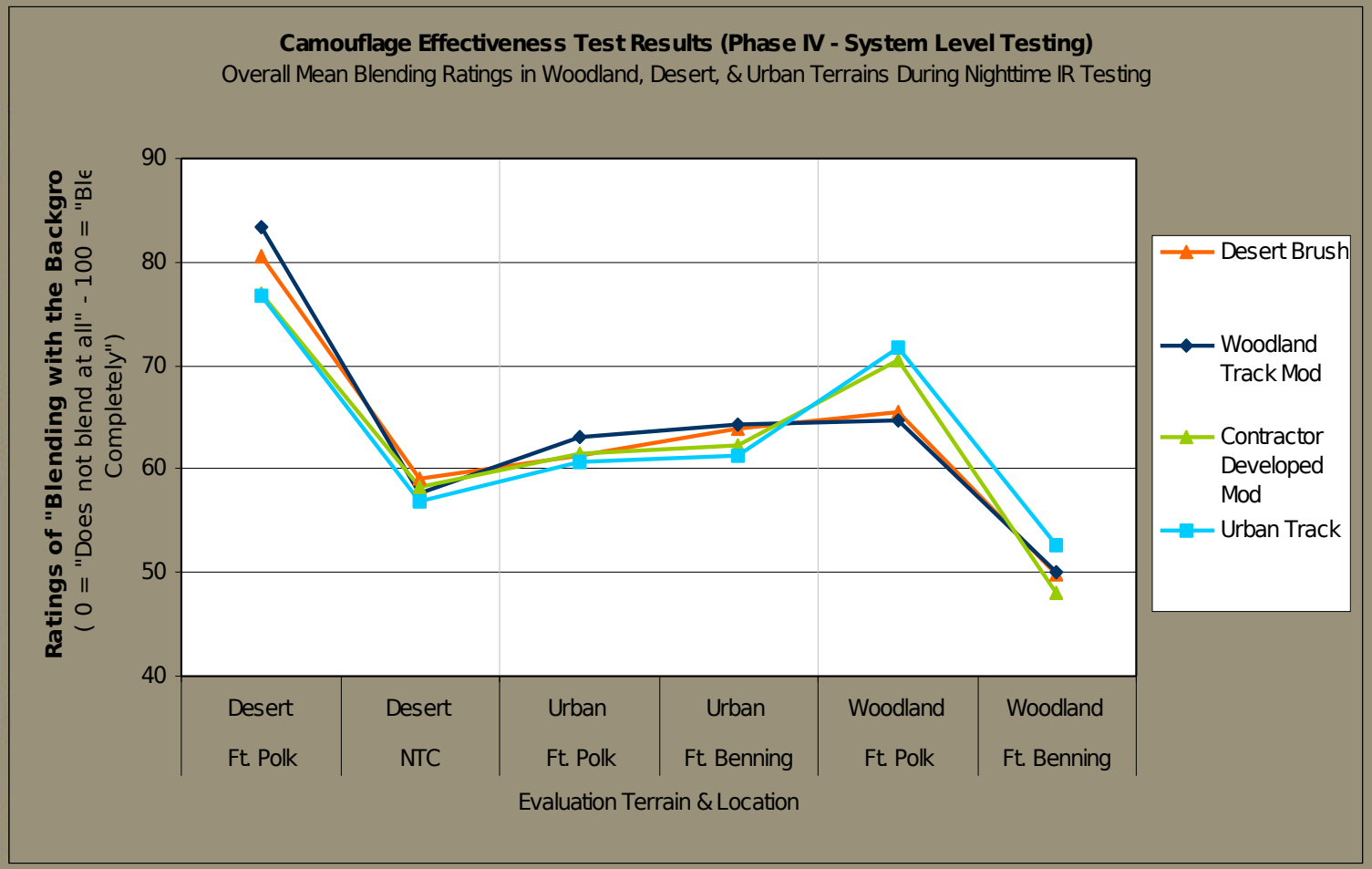
Urban Track

Desert Environment

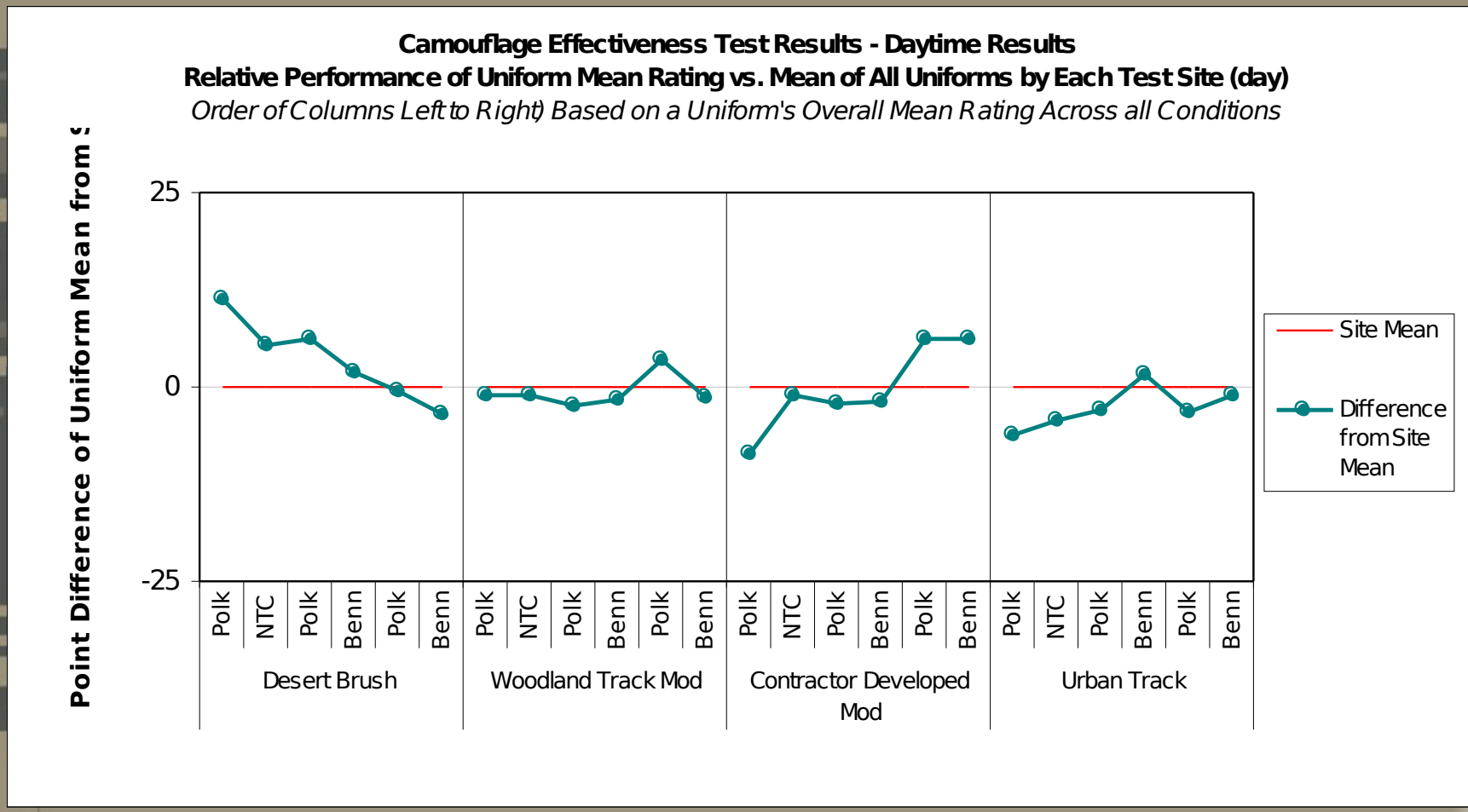
Data Analysis - Day



Data Analysis - Night



Data Analysis – Mean Rating



Data Analysis

- Highest mean blend rating of the four systems tested (Combining all terrains and day/night testing) – Desert Brush Design
  - **Significantly (statistically) better overall mean daytime visual rating than all other designs tested.**
    - There were no significant differences between Woodland Track Mod, Contractor-Developed Pattern Mod, and Urban Track in daytime visual testing.
  - **Received the highest mean daytime visual ratings, versus the other 3 designs, in 4 out of 6 of the terrains used in testing.**
- Received the most number of mean background ratings (14) in the high performing range[1], and the least number of mean ratings (1) in the low performing range[2].
  - All camouflage designs were evaluated in a total of 24 backgrounds by the observer groups, in both day and night conditions, producing 48 total mean ratings.

[1] Ratings falling above 70 on a 100pt scale from “Does not blend at all” to “Blends Completely”.

[2] Ratings falling below 30 on a 100pt scale from “Does not blend at all” to “Blends Completely”.

Data Analysis Cont.

- **Desert Brush's highest ratings were in Desert and Urban environments.**
  - The contractor-developed pattern mod design received the highest ratings in woodland environments, but was rated low in Desert and Urban terrains.
  - Woodland Track Mod received ratings typically several points lower than Desert Brush.
  - Urban Track was typically the 3rd or 4th worst performer in each site (with the exception of one urban site where it tied with desert brush for the highest rating).
- **Nighttime (NIR) testing showed no significant or notable differences in the performance of the four camouflage designs.**

Conclusions

***Desert Brush* –**

Best Overall Performing Camouflage Design in System Level Testing

- Desert Brush is *Significantly Better* than the Other Three Systems.
- Desert Brush has *Enhanced Performance in the Visual Spectrum.*
- Acceptable NIR Performance Across All Three Terrains for All Four Systems.
  - No statistical difference in nighttime performance among all four systems.
- Best to Worst: Desert Brush, Woodland Track Mod, Contractor-Developed Mod, and Urban Track.

Acknowledgements

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